

THE CLAIMS

1. An error diffusion halftoning method comprising:
 using a quantizer having an input and an output; and
 using a system having a bandpass characteristic to modify the quantizer input
 without feeding the quantizer output directly into the quantizer input.

2. The method of claim 1, wherein if the quantizer was replaced by a source
 for injecting uncorrelated noise and no input was present to the system, the system
 would shift the noise injection from a high frequency range to a middle frequency
 range.

3. The method of claim 1, wherein using the system includes using at least
 one filter to provide the bandpass transfer function $B(z)$

$$B(z) = \frac{(1 - \alpha)H(z) + \alpha H(z)K(z)}{1 - \alpha H(z) + \alpha H(z)K(z)}$$

where $H(z)$ and $K(z)$ are transfer functions; and α is a scalar that controls pixel
 clustering.

4. The method of claim 3, wherein coefficients of the transfer functions $H(z)$
 and $K(z)$ sum to unity at dc, whereby bandpass shaping behavior of the bandpass
 transfer function is mean-preserving.

5. The method of claim 1, wherein using the system includes low pass filtering
 the quantizer output with a first linear weighting filter, generating an error signal from
 the filtered output signal and a quantizer input signal; and low pass filtering the error
 signal with a second linear weighting filter.

6. The method of claim 1, wherein using the system includes generating an
 error in response to the quantizer input and output; and applying an infinite impulse

response filter to the error signal, an output of the infinite impulse response filter used to modify the quantizer input.

7. Apparatus for performing error diffusion halftoning, the apparatus comprising:

a quantizer having an input and an output; and

filtering means having an effective bandpass transfer function for modifying the quantizer input without feeding the quantizer output directly into the quantizer input.

8. The apparatus of claim 7, wherein the bandpass transfer function $B(z)$ is

$$B(z) = \frac{(1 - \alpha)H(z) + \alpha H(z)K(z)}{1 - \alpha H(z) + \alpha H(z)K(z)}$$

where $H(z)$ and $K(z)$ are transfer functions; and α is a scalar that controls pixel clustering.

9. Apparatus for performing error diffusion halftoning, the apparatus comprising a processor for performing quantization, and using an error signal filtered with a bandpass characteristic to modify the quantizer input without directly feeding a result of the quantization to an input of the quantization.

10. The apparatus of claim 9, wherein the processor uses the transfer function $B(z)$ to produce the filtered error signal, where

$$B(z) = \frac{(1 - \alpha)H(z) + \alpha H(z)K(z)}{1 - \alpha H(z) + \alpha H(z)K(z)}$$

where $H(z)$ and $K(z)$ are transfer functions; and where α is a scalar that controls pixel clustering.

11. The apparatus of claim 10, wherein coefficients of the transfer functions $H(z)$ and $K(z)$ sum to unity at dc, whereby the bandpass transfer function has a mean-preserving behavior.

12. The apparatus of claim 9, wherein the filtered error signal is produced by low pass filtering the result of the quantization output with a first linear weighting filter, generating an error signal from the filtered output signal and the quantization input; and low pass filtering the error signal with a second linear weighting filter.

13. The apparatus of claim 9, wherein the filtered error signal is produced by generating an error in response to the quantization input and the result of the quantization; and applying an infinite impulse response filter to the error signal, an output of the infinite impulse response filter used to modify the quantization input.

14. The apparatus of claim 9, the processor generating the filtered error signal with a system wherein if the quantizer was replaced by a source for injecting uncorrelated noise and no input was present to the system, the system would shift the noise injection from a high frequency range to a middle frequency range.

15. An article for a processor, the article comprising memory encoded with data for instructing the processor to perform error diffusion halftoning, the error diffusion halftoning including performing quantization, and filtering with an effective bandpass characteristic without using an output of the quantization to directly influence an input of the quantization.

16. The article of claim 15, wherein the filtered error signal is used to modify the quantization input.

17. The article of claim 15, wherein the filtering is based on the noise transfer function

$$\frac{1 - H(z)}{1 - \alpha H(z) + \alpha H(z)K(z)}$$

where $H(z)$ and $K(z)$ are transfer functions; and α is a scalar that controls pixel clustering.

18. The article of claim 17, wherein coefficients of the transfer functions $H(z)$ and $K(z)$ sum to unity at dc.

19. The article of claim 15, wherein using the filtering includes low pass filtering the quantization output with a first linear weighting filter, generating an error signal from the filtered output signal and the quantization input; and low pass filtering the error signal with a second linear weighting filter.

20. The article of claim 15, wherein the filtering includes generating an error from the quantization input and output; and applying an infinite impulse response filter to the error signal, an output of the infinite impulse response filter used to modify the quantization input.

21. A printer comprising:

a print engine; and

a processor for performing error diffusion halftoning, the halftoning including performing quantization, and using an error signal filtered with an effective bandpass characteristic to influence the quantization without using a result of the quantization to directly influence an input of the quantization, an output of the quantization supplied to the print engine.